

## **Alan Baxter's Residential Basements Report: Summary of Report**

This detailed technical report is aimed at structural engineers, architects, contractors and applicants for basement design. It provides background information on hydrology, geology and flooding issues in the City of Westminster and their impact on basement design, as well as some limited information on other issues which may affect construction, such as construction management and temporary works, sustainability and trees.

The report identifies that basements can be constructed in any area of Westminster but that there are varying levels of risk involved according to ground conditions and construction technique used.

It highlights the importance of detailed investigation of the ground conditions and adjacent structures by a structural engineer at an early stage in the design process. It suggests detailed information should be presented as part of a planning application in the form of a structural methodology statement (SMS) and recommends the content and level of detail that this SMS should contain.

### **Ground Conditions & Flood Risk**

Those designing and building new basements need a thorough understanding of the flood risks and groundwater conditions. Desk-top analysis and site investigation should be undertaken.

*The desk study should include the site history, age of the property, site topographical survey, geology, historic river courses and underground infrastructure, including utilities services, drains and tunnels.*

The report identifies and maps the main types of ground conditions found in Westminster. The following need to be considered: routes of historic water courses (the Tyburn, the Westbourne and their tributaries), geological conditions including presence of London Clay at the surface (to the north of the City) London Clay overlain with sands and gravel, Langley Silt (brickearth), Alluvial deposits (laid down by the River Thames and along the routes of the Tyburn and Westbourne), areas overlain with fill or made ground. Areas at the boundaries between the different geological layers at the surface and existence of eroded shallow channels in the surface of the clay will also have an impact.

It identifies the main areas and types of flood risk in Westminster including risk of tidal flooding and rapid inundation areas, local surface water flood risk areas including critical drainage zones and where sewer flooding may present a risk. It suggests flooding of

basements is usually caused by a combination of events (surface water, groundwater and sewers).

Basements planned in flood risk areas will need to be designed to take account of combined risks. The SMS should provide details of flood risk, surface water flooding, critical drainage areas explaining how these are addressed in the design. If the basement is in Flood Zone 3, a full flood risk assessment should be carried out. All drainage from basements should be fitted with one way valves. Basements within critical drainage areas or areas within local surface water flood risk zones should have a pumped drainage system.

### **Groundwater Considerations**

In relation to groundwater, the report identifies that this is only a consideration in certain circumstances. Particular consideration to groundwater should be given where:

- Basements extend through the gravels below the perched water table into the underlying London Clay or which have their lower levels close to the level of Upper Aquifer (within 300mm of it).
- Basements are in the vicinity of the historic routes of the Westbourne and Tyburn.
- New basements are proposed to existing houses with basements or lower ground floors, where the existing perched water level is close to the lowest occupied area of the existing buildings.

*The SMS should provide details of monitoring. If groundwater is present, the levels should be monitored for a period of time. An analysis of the Upper Aquifer (when it exists) and how the basement may impact on any groundwater flow should also be carried out.*

Potential cumulative impacts should be considered. If an assessment of the cumulative effect of basements in a terrace shows this to be a possible problem, the design of a basement should provide drainage or engineered flow arrangements below or around it.

Any basement proposal which is to be constructed below the Upper Aquifer must demonstrate that it will not increase the flood risk to adjoining properties.

### **Appropriate Construction Techniques**

Different construction techniques: underpinning, piled walls (contiguous or secant) and king post are described in the report along with detail of different considerations for each. Choice of construction technique will depend on:

- The ground conditions, ground water conditions and flood risk
- Whether the basement is under the existing house, under the garden outside the footprint of the main house or a combination of the two conditions.

- The depth of the proposed basement.
- The structure of the existing building and of its neighbours.

*Site investigation should be undertaken which is relevant to the site, together with trial pits to show the existing foundations and the material they are founded on, for all walls which may be impacted by the proposals.*

*An appraisal of the existing structure including drawings to show the arrangement of the existing structures should identify previous alterations and any obvious defects. It should also assess the condition and location of the building with adjoining buildings. This should include opening up works to investigate the existing structure, which should be summarised on a set of drawings.*

### **Depth and location of basements**

Type of construction will depend on location and depth of basements.

Deeper basements formed by underpinning are more likely to result in significant ground movements, which may result in structural damage to the building being underpinned and to the adjoining construction. The report suggests basements formed by underpinning should be limited to one storey. Deeper basements should be confined to gardens of larger properties or where the majority of the site is being redeveloped.

Basements below rear gardens should generally be formed within a piled wall, sheet piled wall or King Post Wall. The use of reinforced concrete walls formed sequentially using underpinning techniques should not be used where they are within 6m of a site boundary or adjacent building. A contiguous piled wall is most suitable for larger residential properties. It is beneficial for the existing adjoining buildings if these basements are designed and built so that they are structurally independent of the structures of the adjoining houses.

Basements under semi-detached or terraced properties which are founded on shallow foundations and where there is a history of structural movement need particular consideration. Basements in these locations can be formed without underpinning and in cases where there are ground movements of adjoining properties founded on clay, other techniques such as piled walls may be more appropriate and preferable.

Underpinning that extends into the Upper Aquifer in gravels and sands should be avoided and alternative techniques for forming basements in these ground conditions considered.

*The SMS should demonstrate details of the engineering design have been advanced to detailed proposals stage. Relevant drawings should be provided to show how the designers have addressed the following: ground conditions and groundwater, existing trees and infrastructure, drainage, flooding, vertical and horizontal loading, structural*

*engineering general arrangement and details; drawing showing underpinning, piled wall etc.*

## **Ground Movements**

*The SMS should include an assessment of movements expected and how these will affect adjoining or adjacent properties. This needs to include both short term and long term effects. The design and construction should aim to limit damage to all buildings to a maximum of Category 2 as set out in CIRIA Report 580.*

*The SMS should provide details of sequences of construction and temporary propping to demonstrate how the basement can be built to prevent movements exceeding those predicted. It should show how the horizontal and vertical loads are supported and balanced at all stages of construction and consider the interaction between permanent works and temporary works.*

The report identifies that for single storey basements which are properly designed and constructed the movements are small. They may not be noticeable or result in just minor superficial damage to finishes of the building over or adjacent to the basement

By adopting methods of construction which provide continuous or near continuous support to the ground, with propping (both temporary and permanent) designed to control movements, the effects of subterranean development can be mitigated and controlled. **Movements, when major works are carried out, occur both in the short term as well as over a longer period (of a year or more) as the structures settle down.**

## **Other Issues**

The report provides advice for owners in relation to the Party Wall Act.

The report does not identify any structural engineering reasons for limiting the extent of gardens left undeveloped where basement excavation is undertaken. It identifies the importance of considering trees, having regard to guidance in BS5857, 2012. Any basement which is close to, or within the Root Protection Area must be accompanied by an arboriculturalist report to justify the proposals.

The report does not provide any evidence that basement development is less sustainable.